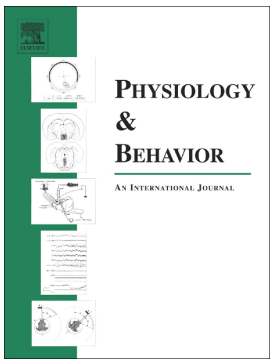

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Violence and Aggression in Young Women: The Importance of Psychopathy and Neurobiological Function

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Abstract

Psychopathy is one of the most researched risk factors for violence. Yet, research in women is sparse. The present study aimed to test if the link between the four-facet structure of psychopathy and interpersonal violence and aggression was moderated by neurobiological function (indexed by resting respiratory sinus arrhythmia; RSA). Results showed the lifestyle and affective facets were associated with reactive aggression and these associations were moderated by low resting RSA. The interpersonal, affective, and antisocial facets were associated with proactive aggression but no moderation effect was found. The affective and antisocial facets of psychopathy were associated with histories of interpersonal violence, however, only the affective facet was moderated by low RSA. This is the first study in young women to demonstrate the link between affective psychopathic traits and interpersonal violence and reactive aggression is via aberrant prefrontal cortex functioning.

Keywords: psychopathic traits; reactive aggression; proactive aggression; violence; respiratory sinus arrhythmia; female violence

1. Introduction

Psychopathy has become one of the most widely recognized risk factors for aggressive and violent behavior, yet research exploring the link in women has been neglected. Indeed, the prevalence of psychopathy in women is lower (0.3%-0.7%) when compared to men (1-2% [1–3]) but high levels of these traits, regardless of sex, pose a significant risk to the community with estimates suggesting 20-40% of all violent crimes are committed by individuals with high levels of psychopathic traits [4,5]. Not only are these individuals responsible for a high percentage of crimes, but their violence is also more dispassionate, sadistic, gratuitous, and nondiscriminatory [6,7]. Unsurprisingly, then, most (approximately 93%) psychopaths become involved in the criminal justice system [3,8,9], which makes psychopathy one of the costly psychiatric disorders [3]. This makes the study of psychopathy an important endeavor; for targeting a small percentage of the population who are high risk and chronically violent will yield a significant effect in reducing the number of victims.

A large proportion of research has been conducted in male prisoner and inpatient samples, yet, few studies have aimed to understand the link between psychopathy and violent and aggressive behavior in community women. This is problematic as violence and aggression committed by women may be influenced differently based on contextual factors, such as the environmental setting (e.g., prison versus in the community; [10]). It may be that risk factors found in prisons, where the environment is strictly controlled and exposure to criminal thinking is greater, may differ from those found in community and university samples. Indeed, the university context is unique in that for many of these young people this is their first experience of independent living, and this life stage is associated with higher engagement in risky behaviors [11,12].

In addition, although psychopathy has a longstanding empirical association with neurobiological dysfunction [13], at present there are no studies that have tested moderating

effects of neurobiological functioning in the link between psychopathic traits, violence, and aggression subtypes in young women. Therefore, the link between psychopathic traits and aggressive and violent behavior remains poorly understood, especially in women. To date, this is the first study to evaluate the moderating role of a neurobiological marker of prefrontal cortex (PFC) function in the link between psychopathic traits and violence and aggression subtypes in women.

1.1 Psychopathy and Violent Behavior

In recent years, research on psychopathy reflects a greater understanding of its neurodevelopmental origins and diverse manifestation [14,15]. Notably, the most recent iteration of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; [16]) introduces the ("presence of limited prosocial emotions") subtype of childhood conduct disorder (CD) based on presence or absence of callous-unemotional (CU) traits, even outside of aggressive interactions. Although there is an active debate on how childhood psychopathic traits are best measured [17], CU traits are considered a downward extension of the affective facet of psychopathy in adults [18]. This has led to a more refined developmental understanding of the link between (different nomenclatures of) psychopathic traits and aggressive and violent behavior that considers the typical role of emotion in an individual's aggressive acts [19], such as the distinction between proactive and reactive aggression.

Most recently, the construct of psychopathy, as traditionally measured by the Psychopathy Checklist-Revised [PCL-R; 20] and its derivative measures [e.g., Self-Report Psychopathy Scale [SRP]; 21], consists of a four-facet model that includes emotional reactivity as a defining characteristic. These facets are; interpersonal (i.e., grandiosity, superficial charm, manipulative); affective (i.e., lack of remorse, shallow affect, callous lack of empathy); lifestyle (i.e., boredom susceptibility, impulsivity, lack of realistic long-term goals); and antisocial (i.e., poor behavioral controls, juvenile and adult delinquency). Using the four-facet model on the PCL:SV, Vitacco and colleagues [22] found the affective and

antisocial facets prospectively predicted violence in a mixed-sex civil psychiatric patient sample. However, studies including male prisoners typically show the affective facet is not associated with violence but the antisocial facet is [23–25]. More recently, in a community sample of males without a history of violence, the affective and lifestyle facets on the SRP were associated with fighting [26]. In addition, higher scores on the affective facet increased the odds of having perpetrated violence with and without a weapon and having caused physical injury [26]. Thus, in noncriminal populations without a history of arrest, the affective facet is associated with multiple forms of violence, while the antisocial facet is only related to a higher frequency of physical fighting. In contrast, males with a history of arrest were found to be at greater risk of assault with and without a weapon if they were higher on either the lifestyle or antisocial facets [26]. The affective facet was only associated with causing physical injury. This highlights the importance of studying psychopathy across multiple populations (i.e., criminal and noncriminal) and using the dimensional construct of psychopathy.

Indeed, context plays a significant role in female violence [10], therefore it is likely to expect psychopathy to be differently related to aggressive and violent behavior in non-forensic or clinical samples. Drawing from research including female prisoners, the affective and antisocial facet have been found to prospectively predict chronic violence over a nine-month period during incarceration [27]. In a recent study, women who were convicted of a violent crime that was not drug-related were found to have higher scores on the affective facet, whereas women convicted drug-related violent crime scored higher on the antisocial facet [10]. Further, research from a community sample has found the affective facet on the PCL:SV was associated with higher levels of physical aggression for women but not for men [28]. Based on this limited amount of research it seems that the affective facet is related to more severe forms of violence in women, while the antisocial facet is related to violence across contexts for both sexes.

1.2 Proactive and Reactive Aggression

Proactive aggression is goal-directed and predatory and has been linked to psychopathic traits and lower physiological arousal and anxiety [29–31]. In contrast, reactive aggression is characterized as an aggressive response to minor or perceived provocation or threat and has been associated with poor behavioral and cognitive control [32], and negative emotionality and emotion dysregulation [33,34]. Although psychopathic traits are typically associated with proactive aggression over reactive aggression, person-centered analysis has demonstrated that children and adolescents with higher levels of psychopathic traits, particularly the affective features, engage in both reactive and proactive aggression [32,35,36]. However, using the dimensional construct of psychopathy has revealed important distinctions.

A meta-analysis including 53 studies found the interpersonal facet was most strongly related to proactive aggression, while the lifestyle facet was most strongly related to both proactive and reactive aggression [37]. A study testing the relation between aggression subtypes and psychopathy, using the psychopathic personality inventory [PPI-R; 38] and the Levenson Self-Report Psychopathy Scale [LSRP; 39] found important sex differences in a sample of university students. Self-centered impulsivity (e.g., poor impulse control, manipulativeness) on the PPI-R was associated with higher proactive aggression in men than women, while higher factor 2 psychopathic traits (e.g., impulsive and uncontrolled behavior) on the LSRP were associated with higher levels of reactive aggression in women than in men [40]. Although the authors did not test the four-facet model, this important research demonstrated the associations between psychopathy and aggression subtypes differ for men and women. The authors suggest that sex differences may have emerged specifically for behavioral psychopathic traits (e.g., the lifestyle facet) because compared to men, women with these features may exhibit higher levels of emotional reactivity leading to greater reactive aggression [40]. This is consistent with research conducted in a sample of detained

female adolescents, whereby higher reactive aggression was associated with poorly regulated emotion and anger to perceived provocation [41]. Although in 2015, Hecht and colleagues highlighted that future research is needed to explore "the mechanism underpinning this [sex] moderation" (p. 10), the mechanisms of psychopathy-related female violence and aggression remains largely unexplored.

1.3 Neurobiological Function as a Moderator

Proactive and reactive aggression may differentially relate to the sympathetic and parasympathetic nervous system activity at rest and under stress [42]. A possible psychopathy-violence and-aggression moderator may be resting parasympathetic tone. Resting respiratory sinus arrhythmia (RSA) indexes parasympathetic efference to the heart via the vagus (10th cranial) nerve [43,44], and has become a widely used index of neurobiological vulnerability to emotion dysregulation [43,45–48]. An association between RSA and aggressive and violent behavior has been well-established [32,49–52]. However, it seems that low resting RSA is most related to reactive aggression over proactive aggression [49,53], which is unsurprising as low RSA is considered a marker for vulnerability to emotion dysregulation. Thus, RSA may serve as a marker of top-down emotion regulation capability, which may be impaired in people with psychopathic traits. Indeed, children and adolescents with high levels of psychopathic traits (e.g., callous-unemotional traits) have been found to have low resting RSA [32,54,55]. However, prior research has typically studied mixed-sex samples, and not accounted for sex difference [see 53].

Neuroimaging research shows the medial prefrontal cortex and orbitofrontal cortex have influence over parasympathetic activity through the limbic and brainstem structures, and this association is bidirectional [56]. In addition, parasympathetic activity has been related to blood flow to the ventromedial prefrontal cortex (vmPFC) and the anterior cingulate cortex [ACC; 57]. Thus, RSA can be considered a marker of PFC function, which may explain why many disorders characterized by PFC dysfunction are also associated with aberrant RSA

activity [58]. Relatedly, fMRI research has found psychopathy to be associated with dysfunction in many of the regions linked to RSA activity, including reduced activity in the vmPFC during fear conditioning [59], moral decision making [60], and emotional processing, and less affect-related activity in the ACC and amygdala [61]. Based on the neuroimaging literature, psychopathic traits are related to greater dysfunction in brain regions involved in affective processing and the interconnectivity between the PFC via affect-related neural circuitry, which may result in the production of atypical parasympathetic nervous system (PNS) activity (e.g., low resting RSA). In light of sex differences in adolescent development of frontocortical neurocircuitry [e.g., 62], it stands to reason that psychopathic traits would be manifested differently in girls and women in terms of both behavioral and physiological correlates. Indeed, CU traits showed a positive correlation with volume of the anterior insula (a key emotion- and behavior-regulatory brain region [63]) in adolescent boys, but not in girls [64]. However, this is yet to be explored in emerging adult women and as a moderator between psychopathy and violence.

This is problematic as there are well-established sex differences in psychopathy, emotion, and aggressive and violent behavior, as well as the link between RSA and aggression [27,29,51,65–69]. Thus, the present study will be the first female dedicated research to explore the moderating role of neurobiological function (RSA) in the link between psychopathic traits and reactive and proactive aggression and violent behavior.

1.4 The Present Study

Following from this discussion, it is expected that female psychopathic traits to be associated with aggressive and violent behavior, but associations would differ between psychopathy facets. Based on prior sex-difference research, we hypothesized that higher levels of affective and interpersonal psychopathic traits would be associated with proactive aggression, while reactive aggression would be associated with higher scores on the lifestyle and antisocial facets. Further, we expected the affective and antisocial facets would be

positively associated with interpersonal violence. We also expected that in a female sample, lower resting RSA would be associated with psychopathic traits and aggressive and violent behavior that are marked by emotion regulation problems, that is, reactive aggression, histories of interpersonal violence, and the lifestyle facet of psychopathy. The primary aims were to test the moderating role of RSA on the associations between psychopathic traits and aggression subtypes and interpersonal violence. It was expected that RSA would moderate the association between elevated lifestyle facet scores and reactive aggression and histories of violence. No RSA moderation effects were expected for proactive aggression.

2. Method

2.1 Participants

Female participants were recruited from a convenience sample of undergraduate students (N = 83) in the North East of England. Participants were ages 18-22 years (M = 19.57, SD = 1.10), and self-identified as White British (87%), White European (5%), Asian (5%), and Other (3%).

2.2 Procedure

Participants were recruited from online and poster advertisements. Participants were provided with an information letter about the study and enrolled by email. Once participants arrived at the laboratory and signed consent forms, electrodes and a respiration belt were fitted to participants. To accommodate a stabilization for the physiological assessments, participants completed the self-report questionnaires prior to the baseline condition. Next, participants underwent a 3-min rest period during which they sat still and were asked to relax.

2.3 Measures

2.3.1 Psychopathic traits. The Self-Report of Psychopathy Scale-IV [SRP-IV; 21] was used to measure psychopathic traits. The SRP-IV is a derivative of the Psychopathy Checklist-Revised [20]. The SRP-IV consists of 64-items that are reported on a five-point rating scale from 1 (Disagree strongly) to 5 (Agree strongly). In accordance to the PCL-R, the

SRP-IV consists of four facets of psychopathy: interpersonal (e.g., "I purposely flatter people to get them on my side", affective (e.g., "I never feel guilty over hurting others"), lifestyle (e.g., "I've often done something dangerous just for the thrill of it"), and antisocial (e.g., "Every now and then I carry a weapon (knife or gun) for protection"). Prior research has demonstrated the SRP-IV to have good construct validity [70]. In the present study, the internal consistencies for interpersonal ($\alpha = .83$), affective ($\alpha = .73$), lifestyle ($\alpha = .86$), and antisocial ($\alpha = .66$) were questionable to good.

2.3.2 Reactive and proactive aggression. Participants completed the reactive–proactive aggression questionnaire [RPQ; 71]. The 23-item scale captures physical and verbal aggression of each aggression subscale. The reactive and proactive aggression subscales consist of 11 items (e.g., "Gotten angry or mad or hit others when teased") and 12 items (e.g., "Hurt others to win a game"), respectively. Each item is reported on a 3-point scale ranging from 0 (never) to 2 (often). The RPQ is considered a cross-culturally valid measure of aggression [72]. Cronbach's alpha for the total score ($\alpha = 0.81$), and reactive ($\alpha = 0.76$) and proactive ($\alpha = 0.70$) scales were good and consistent with prior research [see 71].

2.3.3 History of interpersonal violence. Fourteen items were used to capture histories of interpersonal violence. Participants reported if they had in the past year committed violence against another person, which was scored as either yes (1) or no (0). Consistent with prior research, items were summed to form a total score [see 49,73]. Items were based on the violence subscale of the Self-Reported Delinquency scale [SRD; 74,75]. These items cover violence directed at parent(s) ("Hit one of your parents?"), friends ("Hit one of your friends?"), romantic partner ("Hit your girlfriend/boyfriend or ex-partner?"), people other than family or friends ("Hit or threatened to hit other people, not friends, family, or partner?"), non-victim specific violence ("beaten someone up", "Choked someone", "Attacked someone with the idea of seriously hurting or killing them?"). Cronbach's alpha for the total score was questionable ($\alpha = 0.66$).

2.3.4 Respiratory sinus arrhythmia. Two Ag-AgCl electrocardiogram (ECG) electrodes were placed in a modified Lead II configuration. Respiration was recorded using a RSPEC-R amplifier with a wireless respiration belt transducer. To ensure the belt was placed at maximum point of sensitivity, participants were asked to exhale, and at full exhalation the respiration belt was fastened around the abdomen. Data were recorded using a Biopac MP150 system with a BioNomadix module transmitter (MP150-BIOPAC Systems Inc., Goleta, CA). The sampling rate was 1kHz. Data were down-sampled and analyzed offline, using the Biopac's Acknowledge 4.3 software. Data were visually inspected for motion artifacts and outliers. The ECG was reduced offline using computer-aided event detection but modified by visual inspection so that ECG artefacts were removed/omitted and mid-beats were created if missing (<.001%) and errors in R-wave detection were adjusted. To compensate for fluctuations due to movement, the electrocardiogram was reduced at 250Hz and respiration was passed through a 0.5 Hz digital band filter. RSA was computed using AcqKnowledge automated function for RSA analysis, which applies the peak-valley method [76]. RSA values reflect the ms difference between the minimum and maximum R-R intervals during each respiration cycle. RSA values were averaged across 30s epochs.

2.4 Data Analyses

To assess associations among the main study variables, bivariate correlations were computed. To test the hypothesis that RSA moderates the relation between psychopathy facets and reactive aggression, proactive aggression, and histories of interpersonal violence, three hierarchical multiple regression analyses were conducted. Hierarchical multiple regressions were performed with R [77] using Psych Package (Revelle, 2015). In accordance to procedures described by Aiken and West [78], simple slopes analysis was used for post hoc testing of the significant interaction terms, using the Pequod Package [79]. Because of differences in scaling of psychopathic traits and RSA, these scores were normalized by transforming values to z-scores. To test for unique effects for reactive and proactive

aggression, the non-target aggression scale was included as a covariate. All regression analyses followed the same structure, with step 1 including the non-target aggression subscale and RSA. Step 2 included step 1 and the four psychopathy facets. Step 3 included all variables from step 2 and the interaction term between each psychopathy facet and RSA. Significant interactions were explored using simple slopes analysis. The proactive aggression scale was positively skewed with positive kurtosis (S=1.93, K=3.16). To resolve this, a square root transformation to improve normality was conducted (S=.83, K=-.47).

3. Results

3.1 Correlations: Psychopathy, Aggression, and Violence

Descriptive statistics and zero-order correlations are displayed in Table 1. The interpersonal and affective facets were highly correlated. Correlations among the remaining psychopathy facets were moderate, and the antisocial facet was not significantly correlated with the interpersonal or affective facets. Resting RSA was negatively associated with reactive aggression and the lifestyle facet, and positively associated with the affective facet. Proactive aggression was positively correlated with all facets of psychopathy, with the strongest associations with the interpersonal and affective facets. Reactive aggression was positively associated with all psychopathy facets except the antisocial facet. Lastly, interpersonal violence was positively associated with the interpersonal, affective, and antisocial facets but not the lifestyle facet.

Table 1. Correlations, Means, and Standard Deviations for the Main Study Variables

Measure	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Age	-										
2. RSA	-.04	-									
3. SRP total	.06	.08	-								
4. Interpersonal	.16	.14	.88***	-							
5. Affective	-.02	.30**	.75***	.74***	-						
6. Lifestyle	.02	-.31**	.73***	.49***	.32**	-					
7. Antisocial	.09	-.17	.35**	.18	-.02	.36**	-				
8. RPQ total	.04	-.07	.61***	.48***	.44***	.49***	.20	-			
9. Proactive aggression	.10	.05	.69***	.69***	.64***	.36**	.27*	.59***	-		
10. Reactive aggression	.09	-.30**	.36**	.25*	.22*	.51***	.19	.72***	.30**	-	
11. Interpersonal violence	-.03	.04	.38***	.26*	.36**	.12	.39**	.31**	.28*	.32**	-
M	19.57	4.49	132.05	39.11	33.54	40.30	20.18	7.99	1.37	6.64	0.92
SD	1.10	0.68	22.29	8.50	6.71	10.03	4.16	4.72	2.15	3.75	1.47

*p <.05, **p<.01, ***p<.001

3.2 Proactive and Reactive Aggression

The results of the hierarchical multiple regression are presented in Table 2. The first regression assessed the link between psychopathy, RSA, and proactive aggression. Step 1 of the regression yielded a significant model (F (2, 80) = 6.78, p = .002), however, only reactive aggression was significant (p<.001) and not RSA (p=.236). Step 2 of the regression produced a significant model (F (6, 76) = 16.15, p < .001), and the interpersonal (p=.022), affective (p=.001), and antisocial facets (p=.004) were associated with higher proactive aggression scores. Including the psychopathy facets accounted for an additional 42% of the explained variance in proactive aggression. Step 3 of the regression, which included the interaction terms, yielded a significant model (F (10, 71) = 10.59, p < .001), however, no significant interactions were found.

Table 2. Psychopathy and Aggression Subtype: The Moderating Role of RSA

	Proactive Aggression					**Reactive Aggression**			
	B	*SE B*	β	ΔR^2		*B*	*SE B*	β	ΔR^2
Step 1				.15**	**Step 1**				.22***
RA	0.36	.10	.40***		PA	1.36	.37	.36***	
RSA	0.12	.10	.13		RSA	-1.14	.37	-.30**	
Step 2				.42***	**Step 2**				.11*
RA	0.14	.08	.15		PA	0.87	.52	.23	
RSA	-0.09	.08	-.10		RSA	-0.72	.42	-.19	
Interpersonal	0.26	.11	.29*		Interpersonal	-0.54	.59	-.14	
Affective	0.39	.11	.44**		Affective	0.42	.61	.11	
Lifestyle	-0.07	.10	-.07		Lifestyle	1.51	.47	.40**	
Antisocial	0.22	.08	.25**		Antisocial	-0.13	.41	-.03	
Step 3				.04	**Step 3**				.18***
RA	0.12	.10	.13		RA	0.61	.48	.16	
RSA	-0.82	.09	-.20		RSA	-0.78	.42	-.21	
Interpersonal	0.23	.11	.26*		Interpersonal	-0.53	.52	-14	
Affective	0.47	.13	.52***		Affective	1.41	.60	.38*	
Lifestyle	-	.10	-.02		Lifestyle	1.70	.42	.45	

	0.02								
Antisocial	0.19	.08	.22*		Antisocial	-0.14	.36	-.04	
Interpersonal x RSA	-0.07	.12	-.07		Interpersonal x RSA	-0.36	.52	.09	
Affective x RSA	-0.17	.17	-.14		Affective x RSA	-1.98	.73	-.41**	
Lifestyle x RSA	0.13	.08	.15		Lifestyle x RSA	-1.11	.34	-.32**	
Antisocial x RSA	-0.10	.09	-.09		Antisocial x RSA	0.31	.42	.07	
Note. RA = Reactive aggression; PA = Proactive aggression; RSA = Respiratory sinus arrhythmia; * p<.05; ** p<.01; *** p<.001									

The second regression tested the associations between psychopathy, RSA, and reactive aggression. Step 1 of the regression produced a significant model (F (2, 80) = 11.36, p < .001), and both proactive aggression (p<.001) and RSA (p=.003) were significantly related to reactive aggression. Step 2 of the regression yielded a significant model (F (6, 76) = 6.23, p < .001), however, RSA was no longer significant (p=.094). From the four-facets of psychopathy, only the lifestyle facet (p=.002) was significantly related to reactive aggression. Next, step 3 included the interaction terms and produced a significant model (F (10, 72) = 7.55, p < .001). The interaction terms between RSA and the lifestyle facet (p=.002), and RSA and the affective facet (p=.009) were significant. Step 3 accounted for an additional 18% of the explained variance in reactive aggression.

Figure 1 displays the results of the post hoc testing using simple slopes analysis for each model. Figure 1a shows reactive aggression was associated with low (-1 *SD*) RSA and high (+1 *SD*) lifestyle psychopathic traits (b= 2.81, p<.001). Also, Figure 1b shows reactive aggression was associated with low (-1 *SD*) RSA and high (+1 *SD*) affective psychopathic traits (b= 3.38, p=.001). In sum, when considered separately, low RSA and the higher lifestyle psychopathic traits were associated with higher levels of reactive aggression, and no other psychopathy facets emerged as significant. However, when including the interaction

term between RSA and the psychopathy facets, affective psychopathic traits were associated with reactive aggression when levels of RSA were low. This was also found for the lifestyle facet of psychopathy.

Figure 1. The moderating effect of RSA on the association between psychopathy facets and reactive aggression in women.

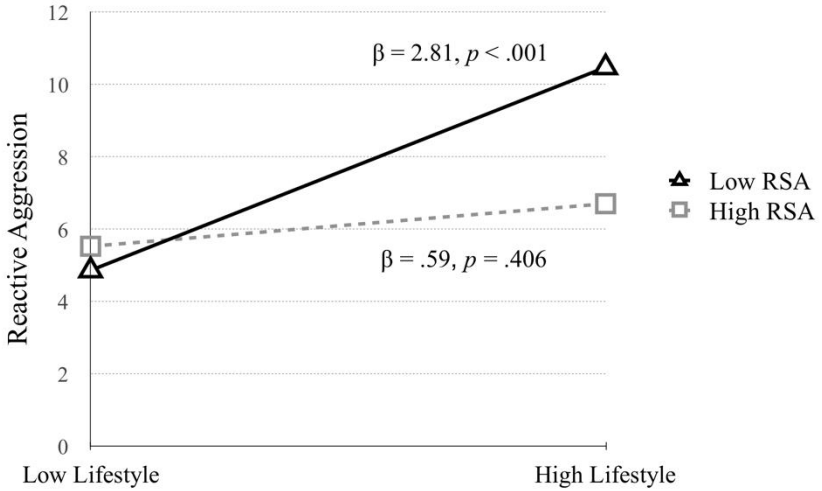

Figure 1a. The moderating effect of RSA on the association between lifestyle psychopathic traits and reactive aggression.

Note. Low and high values represents +1.0 and −1.0 *SD* from the mean.

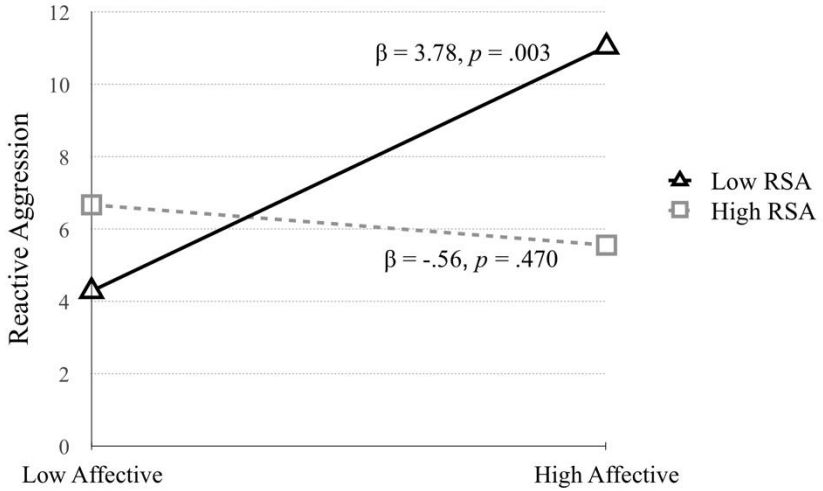

Figure 1b. The moderating effect of RSA on the association between affective psychopathic traits and reactive aggression.

Note. Low and high values represents +1.0 and −1.0 *SD* from the mean.

3.3 Histories of Interpersonal Violence.

To assess if psychopathy and RSA were related to histories of interpersonal violence in women, a hierarchical multiple regression was conducted (see Table 3). Step 1 of the regression, which included only RSA did not yield a significant model (F (1, 81) = 0.11, p = .743). Step 2, which included the psychopathy facets produced a significant model (F (5, 77) = 4.67, p = .001) and explained 23% of the variance in histories of interpersonal violence. The affective (p=.003) and antisocial facets (p=.003) were significantly related to interpersonal violence. Step 3 of the regression resulted in a significant model (F (9, 73) = 5.61, p < .001) and explained an additional 18% of the explained variance in violence. The only significant interaction to emerge was between the affective facet and RSA (p=.030).

Table 3. Psychopathy and History of Interpersonal Violence: The Moderating Role of RSA

	Interpersonal Violence			
	B	*SE B*	β	ΔR^2
Step 1				.00
RSA	0.05	.16	.04	
Step 2				.23***
RSA	-0.07	.17	-.05	
Interpersonal	-0.20	.24	-.14	
Affective	0.72	/23	.49**	
Lifestyle	-0.04	.20	-.03	
Antisocial	0.49	.16	.33**	
Step 3				.18**
RSA	-0.30	.17	-.21	
Interpersonal	-0.29	.22	-.20	
Affective	1.09	.23	.74***	
Lifestyle	0.08	.18	.06	
Antisocial	0.40	.15	.27**	
Interpersonal x RSA	-0.26	.22	-.17	
Affective x RSA	-0.68	.31	-.36*	
Lifestyle x RSA	0.07	.14	.05	
Antisocial x RSA	0.05	.18	.02	

Note. RSA = Respiratory sinus arrhythmia.
* p<.05; ** p<.01; *** p<.001

Probing the interaction using simple slopes analysis revealed higher levels of interpersonal violence was associated with high (+1 *SD*) affective psychopathic traits only at low RSA (-1 *SD*; *b*= 1.77, *p*<.001; Figure 2).

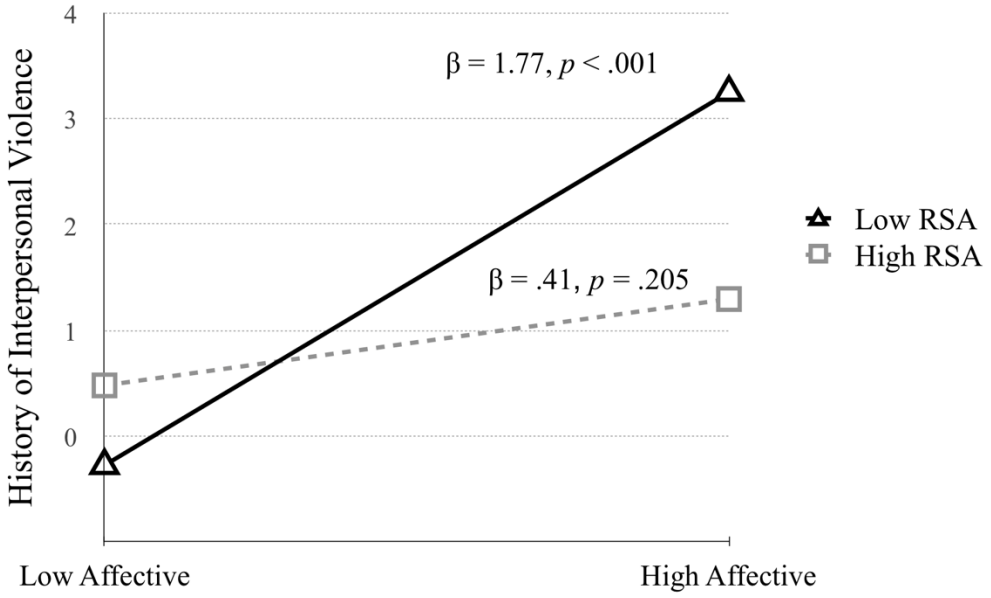

Figure 2. The moderating effect of RSA on the association between affective psychopathic traits and history of interpersonal violence.

Note. Low and high values represents +1.0 and −1.0 *SD* from the mean.

4. Discussion

The aim of the present study was to test if the link between the four-facet structure of psychopathy and interpersonal violence and aggression subtypes was moderated by neurobiological function (RSA). The results showed low resting RSA moderated the association between the lifestyle and affective facets with reactive aggression, and the affective facet with histories of interpersonal violence. These results indicate that a biological vulnerability to emotion dysregulation may explain why women characterized by affective and lifestyle psychopathic traits engage in emotionally driven aggression and interpersonal violence. However, a biological vulnerability to emotion dysregulation (RSA) did not moderate the relation between psychopathy facets and proactive aggression.

Affective psychopathic traits have been found to differentiate women responsible for the most severe forms of violence [27], and the present study extends on this by finding affective psychopathic traits were positively associated with proactive aggression. Thus, women who lack remorse and empathy, and have a callous disregard for others engage in higher levels of goal-directed aggression. Consistent with research in male samples, interpersonal and antisocial psychopathic traits were also associated with higher levels of proactive aggression [37]. Expectedly, there was no moderation effect of low RSA.

In contrast, when assessing the link with reactive aggression, RSA was a valuable contribution to the statistical model. Low resting RSA and the lifestyle facet were associated with reactive aggression, even after controlling for proactive aggression. Further, RSA moderated the relation between the lifestyle facet and reactive aggression. Therefore, young women who were characteristically irresponsible, impulsive, and susceptible to boredom were more likely to engage in reactive aggression if they had lower resting RSA – a neurobiological vulnerability to emotion dysregulation. This is consistent with prior research using a mixed-sex sample (84% male) and the PPI, which found self-report emotion regulation problems mediated the link between self-centered impulsiveness (a reckless and self-centered willingness to take advantage of and blame others) and reactive aggression [80].

Unexpectedly, RSA moderated the association between affective psychopathic traits and reactive aggression. It is important to note that the affective facet was not associated with reactive aggression when entered into step 2 of the regression model. This suggests that women with affective psychopathic traits will engage in reactive aggression if they have a biological vulnerability to emotion dysregulation. Similarly, the affective facet was associated with histories of interpersonal violence, and this was also moderated by RSA. Collectively, these results suggest that interpersonal violence (e.g., violence directed at parents, partners, friends) and aggression in response to provocation in women is associated

with a combination of callousness, lack of empathy and remorse, and PFC dysfunction which impacts emotion regulation capabilities. These results were not expected, as the affective features of psychopathy are characterized by a disconnect of emotionality (e.g., callous disregard for others, lack of empathy and remorse, shallow affect). Yet, prior research has shown that female adolescents with high CU traits do engage in both reactive and proactive aggression [81]. Therefore, the present study builds upon this research by providing a possible mechanism by which affective psychopathic traits are related to reactive aggression in young women.

RSA had been proposed to reflect PFC dysfunction [58]. In some ways, the present study supports this assertion because unlike reactive aggression, proactive aggression was unrelated to RSA, and proactive aggression relies on intact PFC functioning to initiate drawn-out goal-directed behaviors [32]. Further, functional neuroimaging research has shown that during emotion-related tasks, psychopathic traits are associated with aberrant functioning in the vmPFC, ACC, and the amygdala [59,61], all regions of the brain involved in PNS activity [57,58]. Indeed, psychopathic criminals show abnormal connective functioning between the vmPFC and the amygdala [82,83], which may suggest that the aberrant functional connectivity between the vmPFC and the amygdala may be a neurobiological mechanism behind psychopathic socioemotional processing [82]. An extension of this may be that abnormal connective functioning between these brain regions may also explain the link between psychopathic traits and reactive aggression and interpersonal violence, but not goal-directed aggression.

It is important to note that resting RSA was positively associated with the affective facet. This is interesting because higher RSA implies less anxiety and greater dominance during the resting period, which is consistent with the low physiological arousal associated with affective psychopathic traits [84]. However, higher RSA did not moderate the link between the affective facet and proactive aggression. Thus, future research is needed to

explore alternative neurobiological mechanisms of goal-directed aggression in women.

Lastly, the antisocial facet was not associated with reactive aggression. This result was found in both the bivariate correlation and when testing unique effects in the regression, which suggests the null finding was not due to the overlap between psychopathy facets (e.g., antisocial and lifestyle). An explanation may be because most (7 out of 11) items on the RPQ reactive aggression scale specifically focus on emotional (e.g., getting angry) or verbal (e.g., yelling) response to provocation, rather than criminal behaviors (e.g., physical reactive aggression). Therefore, the construct of the lifestyle facet (e.g., acting without thinking) is more closely related to reactive aggression in women than the antisocial facet, which primarily measures criminal tendencies. Instead, the antisocial facet more closely represents the RPQ proactive aggression scale (e.g., carries a weapon, tricks people into giving money, threatened people to get money) and incorporates severe criminal tendencies (e.g., sexual assault, hitting someone with a car, serving prison time). Indeed, the present findings showed women with higher levels of antisocial psychopathic traits were more likely to report higher levels of proactive aggression, as well as having more extensive histories of interpersonal violence.

4.1 Limitations

The findings presented here should be interpreted with several limitations in mind. First, the aim was to explore psychopathic traits in a nonclinical/forensic female population. However, findings from undergraduates may not generalize to the broader community. This is particularly true for the proactive aggression findings, which compared to forensic samples were considered low. However, these levels of proactive aggression are in line with university and community sample research [see 85–88]. Further, because the study involved a nonclinical sample, the measures were mostly self-report. Although the these are widely used and validated, associations may be inflated due to common method variance. In addition, the focus of this paper was the effects of psychopathic traits and aggression in women, therefore,

it remains untested if the same findings are found in male samples, and comparisons are tentative at this stage. This is important because research indicates that psychopathy, neurobiology, and aggression and violence frequently differ by sex [27,51,66]. Next, the present study did not consider heterogeneity in interpersonal violence. Thus, it is unknown if the findings between psychopathy and violence is dependent on the relationship with the victim (e.g., parent, friend, current or ex-partner, stranger). This is significant, as context plays an important role in female violence [10]. Finally, despite mounting evidence that low RSA indexes emotion dysregulation [45], this is the first study to investigate RSA as a moderator in the relation between psychopathic traits and aggression subtypes and interpersonal violence in women. In order to confirm these results, replication in community, clinical, and forensic samples is needed, as well as testing the mediating role of RSA in the link between psychopathic traits and aggressive and violent behavior in longitudinal samples.

5. Conclusion

The present study builds on prior research which has found self-reported emotion regulation problems moderate the link between behavioral psychopathic traits and reactive aggression, and that psychopathic traits are associated with PFC dysfunction [80,89]. Research exploring the associations between psychopathy and violent and aggressive behavior has been largely conducted in male samples, and until now there are no known studies that have tested the neurobiological mechanisms of psychopathy-related female violence and subtypes of aggression. Thus, the present study provides the first data offering insight into how psychopathic traits in young women are related to subtypes of aggression and violence, and highlights the importance of future research to include neurobiological functioning within models of female violence and aggression. Integrating a multidisciplinary approach to understanding female violence will lead to a more accurate model of risk assessment but will also enable violence interventions to become more refined by targeting multiple risk factors at the biological, social, and psychological level.

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Highlights

- Psychopathy facets differentially predicted aggression subtypes in women
- Affective, interpersonal, and antisocial traits predicted proactive aggression
- Lifestyle psychopathic traits and RSA predicted reactive aggression
- Affective and antisocial traits predicted histories of interpersonal violence
- RSA moderated the link in affective traits and violence and reactive aggression
- RSA moderated the link in lifestyle psychopathic traits and reactive aggression